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VALENTINE et al. (43) **Pub. Date: May 16, 2002**(54) **IP ROAMING NUMBER GATEWAY****Publication Classification**(76) Inventors: ERIC VALENTINE, PLANO, TX
(US); LEE DAVIDSON, MCKINNEY,
TX (US)(51) Int. Cl.⁷ H04Q 7/20

(52) U.S. Cl. 455/433; 455/426

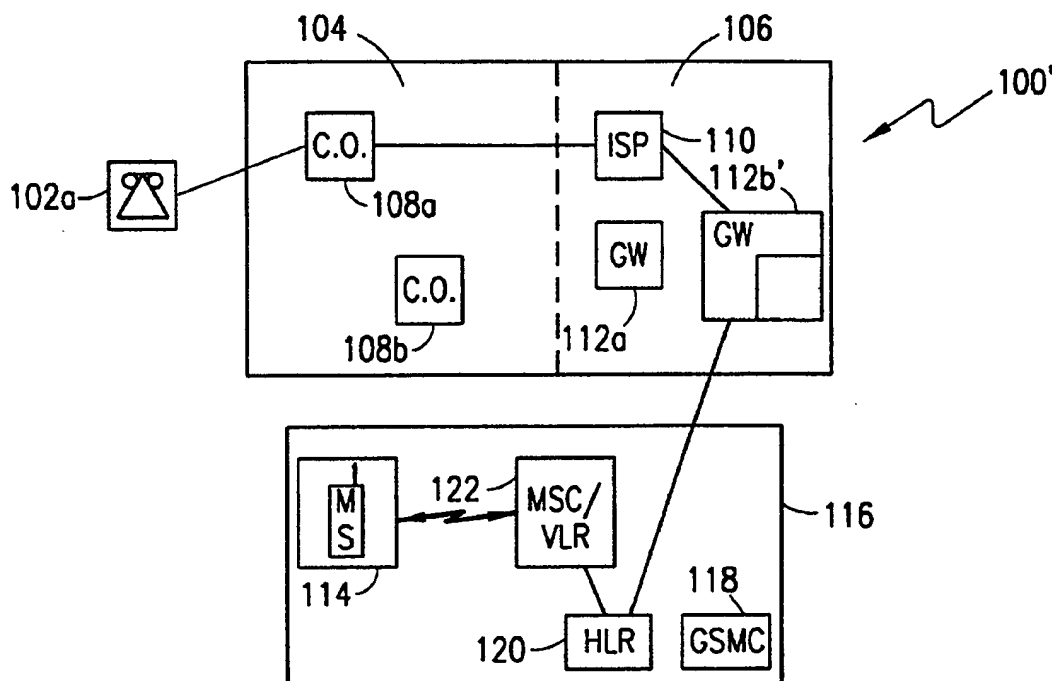
Correspondence Address:
RAYMOND VAN DYKE
JENKENS & GILCHRIST
3200 FOUNTAIN PLACE
1445 ROSS AVENUE
DALLAS, TX 752022799(57) **ABSTRACT**

Methods and arrangements are provided that allow for an Internet gateway to directly request or otherwise access routing and/or location information within a home location register (HLR) within a mobile communications network. This allows for Voice over Internet Protocol (VoIP) communications to be conducted without requiring excessive signaling and/or processing within the mobile communications network. The methods and arrangements can be provided in the form of a standalone node or incorporated into existing nodes, such as, for example, a gateway node within the Internet or a similar network. Verification and/or policing functions are also provided to limit access to the routing and/or location information.

(*) Notice: This is a publication of a continued prosecution application (CPA) filed under 37 CFR 1.53(d).

(21) Appl. No.: 09/176,438

(22) Filed: Oct. 21, 1998



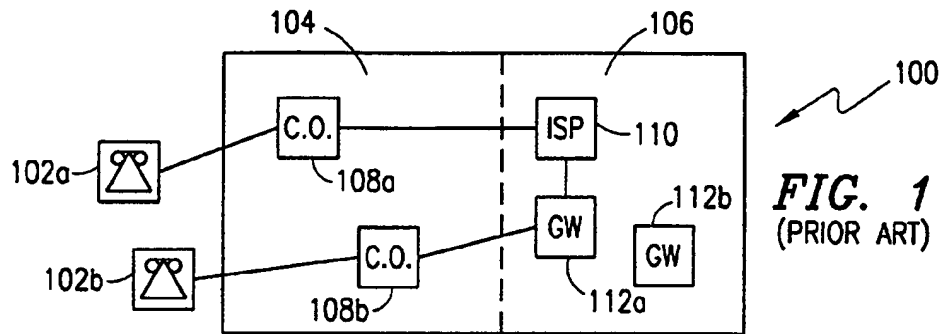


FIG. 1
(PRIOR ART)

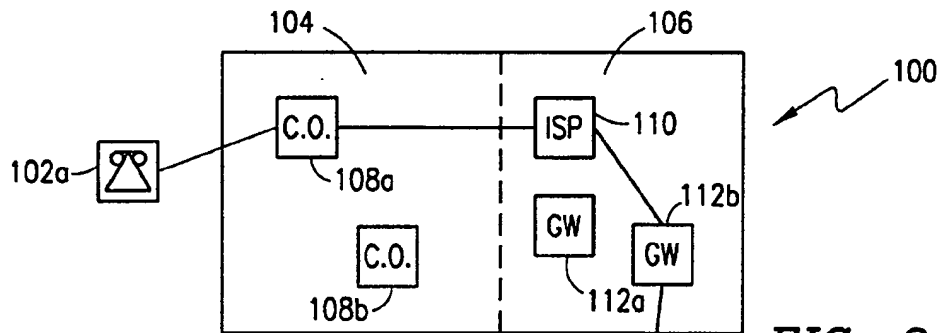


FIG. 2a
(PRIOR ART)

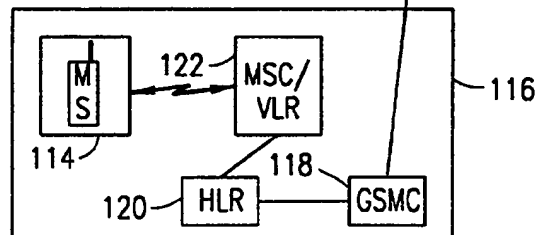
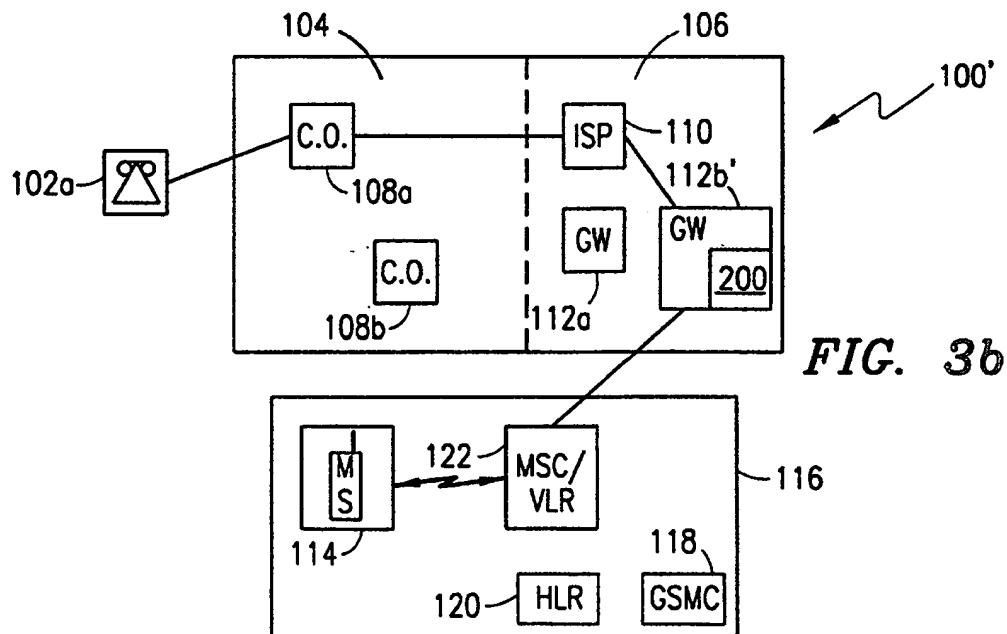
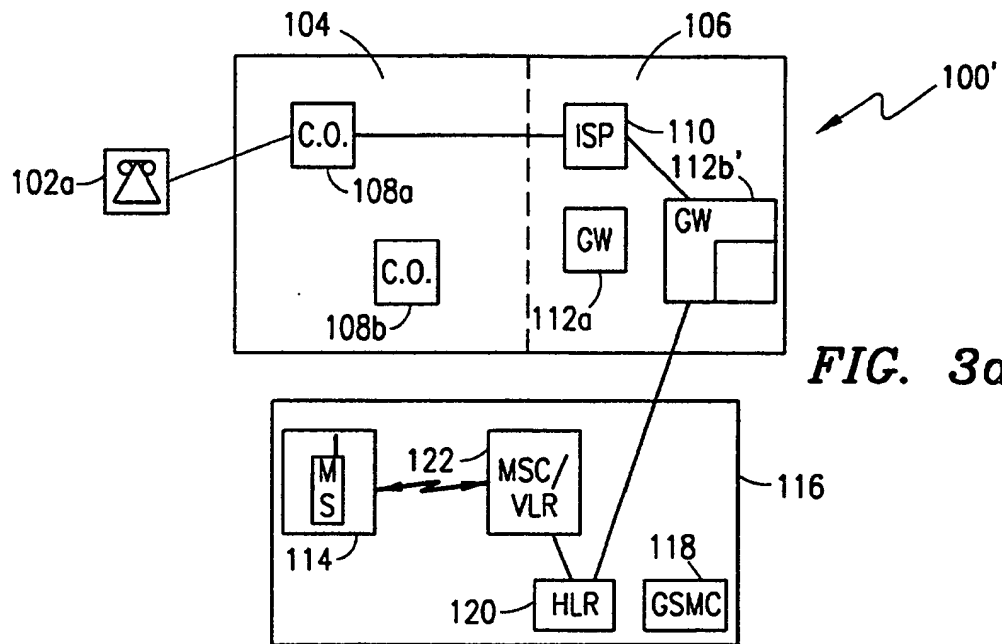


FIG. 2b
(PRIOR ART)



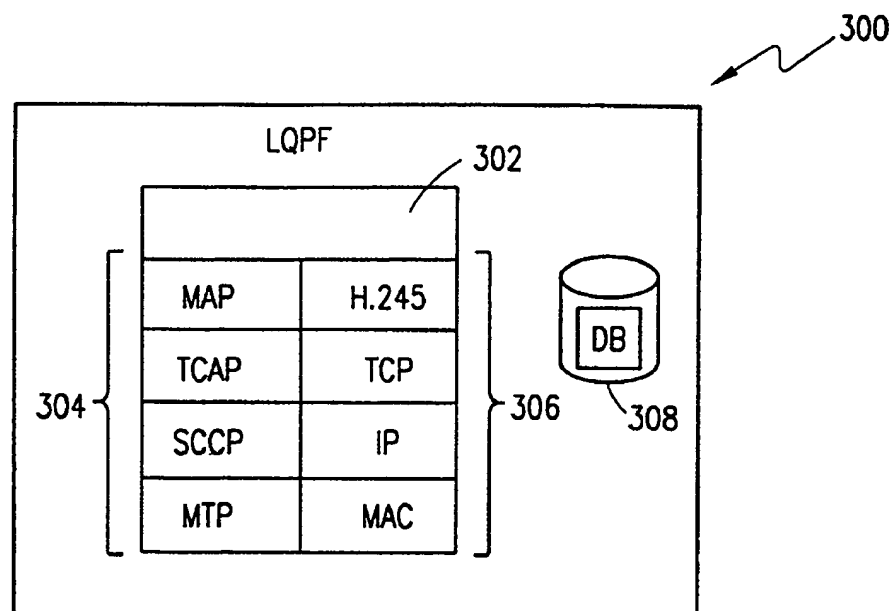


FIG. 4

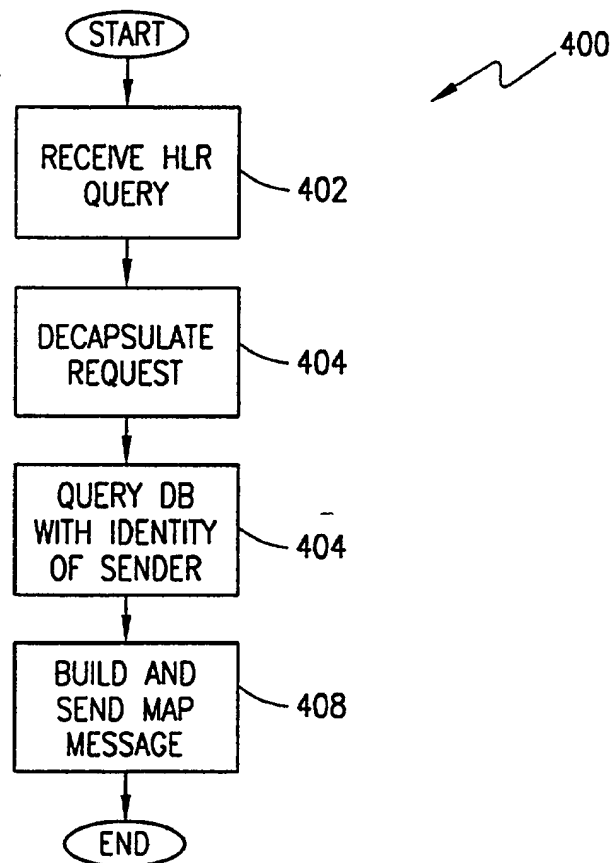


FIG. 5

IP ROAMING NUMBER GATEWAY

BACKGROUND OF THE PRESENT INVENTION

[0001] Field of the Invention

[0002] The present invention relates generally to communication systems, and, more particularly, to improved methods and arrangements for interfacing Internet protocol (IP) networks and similar networks to mobile telecommunications networks.

BACKGROUND AND OBJECTS OF THE PRESENT INVENTION

[0003] There is currently a movement towards enhancing the capabilities of computer networks, such as the Internet, to support traditional telephony operations. The goal is to provide quality voice communications over the packetized Internet. This capability is often referred to as voice over IP (VoIP). VoIP, over the current Internet, for example, can provide acceptable voice communications at a greatly reduced cost to the user, when compared to traditional telephone tolls.

[0004] FIG. 1 is a block diagram depicting an exemplary conventional VoIP call over a communications system 100. Communications system 100 includes terminals 102a and 102b that are used by the calling party and called party, respectively. Terminals 102a-b, can include, for example, a conventional personal computer (PC) that is configured with hardware/software to support VoIP, or simply a telephone (wired or wireless). As shown, terminals 102a-b are each connected to a public switched network 104 and Internet 106, in this exemplary embodiment. When the calling party places a VoIP call to using terminal 102a, a central office 108a, or similar switching center, is used to connect terminal 102a to an Internet Service Provider (ISP) 110, or similar gateway/server. From ISP 110, the call is connected to an appropriate gateway 112a, for example, that is configured to connect the call through another central office 108b, or similar switching center, to terminal 102b. In this manner, the connection through Internet 106 preferably provides a significant long distance connectivity that saves the users money by reducing the associated tolls for the call.

[0005] With this simplified example in mind, FIGS. 2a and 2b depict a call to a mobile station 114 within a mobile communications network, such as, for example, a Public Land Mobile Network (PLMN) 116. Mobile station 114 can be a mobile cellular radio telephone, or similar device, for example. As such, in order to successfully route the call from terminal 102a to mobile station 114, there is a need to determine where mobile station 114 is located within the service area of PLMN 116.

[0006] Thus, communications system 100 in FIGS. 2a and 2b depict exemplary connectivity/functions required to connect terminal 102a to mobile station 114. Referring to FIG. 2a, the call from terminal 102a is placed through central office 108a to ISP 110. ISP 110 connects to gateway 112b. Gateway 112b sends a message over signaling system number 7 (e.g., ISUP) lines to a gateway mobile services switching center (GSMC) 118. GSMC 118 forwards a Send Routing Information message, or similar query, for example, to a home location register (HLR) 120. HLR 120 then

communicates with one or more combined mobile services switching center/visitor location registers (MSC/VLRs), such as MSC/VLR 122. MSC/VLR 122 is configured, for example, through at least one base station (not shown) to provided wireless communications to mobile station 114. Through these connections/functions, the location of mobile station 114 is determined, for example, by having mobile station 114 register with the closest base station and MSC/VLR 122. Information about the current location of mobile station 114 is then passed back to HLR 120 and from there to GSMC 118.

[0007] Referring now to FIG. 2b, GSMC 118 then connects the call through MSC/VLR 122 and eventually to mobile station 114.

[0008] Thus, as can be appreciated, as depicted in the simplified exemplary example in FIGS. 2a and 2b, there are significant amounts of signaling, transmission facilities and processing required to support a call from terminal 102a to mobile station 114 through Internet 106. This is because the Internet or other IP network, for example, does not know where mobile station 114 is located and cannot therefore efficiently route the call to the proper MSC/VLR. As such, additional processing is required to handle the call. Thus, there is a need for improved methods and arrangements that significantly reduce the signaling, transmission facilities and processing burdens placed on the PLMN and IP network resources.

SUMMARY OF THE INVENTION

[0009] The present invention is directed towards improved methods and arrangements that significantly reduce the signaling, transmission facilities and processing burdens placed on mobile communications network and IP network resources by allowing a gateway or similar function within the IP network to directly query subscriber information within the mobile communications network to determine the location of the mobile station being called.

[0010] In accordance with certain aspects of the present invention, therefore, the location of a mobile station within a mobile communications network can be determined by one or more applications within, or connected to, the IP network.

[0011] In accordance with certain further aspects of the present invention, the amounts of signaling, transmission facilities and processing required to support VoIP calls in a mobile communications network are reduced.

[0012] In accordance with still other aspects of the present invention, a policing capability is provided for use in an IP network for controlling access to various resources, such as, for example, a location register, within a mobile communications network.

[0013] In accordance with still further aspects of the present invention, the improved methods and arrangements allow for a VoIP packetized call to be carried further within the overall communications system. For example, it is possible to carry the packetized call all the way to a transcoder/rate adaption unit within a MSC/VLR, where the speech traffic is then converted directly to its over-the-air format without an intervening decoding, for example, to a G.711 PCM format. Thus, the IP voice traffic is carried as far as possible, while maintaining the integrity of the supporting Common Channel Signaling network.

[0014] A more complete appreciation of the present invention and the scope thereof can be obtained from the accompanying drawings which are briefly summarized below, the following detailed description of the presently-preferred embodiments of the invention, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] A more complete understanding of the method and apparatus of the present invention may be obtained by reference to the following Detailed Description when taken in conjunction with the accompanying Drawings wherein:

[0016] FIG. 1 depicts a block diagram of a conventional communications system configured to support voice over Internet protocol (VoIP) calling;

[0017] FIGS. 2a and 2b depict block diagrams of a conventional communications system configured to support voice over Internet protocol (VoIP) calling to mobile communications network resources;

[0018] FIGS. 3a and 3b depict block diagrams of a n improved communications system having an IP roaming number gateway configured to support voice over Internet protocol (VoIP) calling to mobile communications network resources, in accordance with certain embodiments of the present invention;

[0019] FIG. 4 is a block diagram depicting a location query and policing function (LQPF) arrangement for use in the IP roaming number gateway of FIGS. 3a-b, in accordance with certain preferred embodiments of the present invention; and

[0020] FIG. 5 is a flow-chart depicting a portion of a policing process for use in the LQPF of FIG. 4, in accordance with certain embodiments of the present invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EXEMPLARY EMBODIMENTS

[0021] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

[0022] FIG. 3a, which is similar to FIGS. 1 and 2a-b, depicts an improved communications system 100'. As shown, within Internet 106, or similar network, there is provided an improved gateway 112b' having a roaming number application 200 that is configured to allow for direct querying/access to subscriber information (e.g., location information) associated with mobile station 114. The improved gateway 112b' as such, becomes a IP roaming number gateway that is capable of determining where mobile station 114 is located within PLMN 116, for example. Thus, as depicted, gateway 112b' directly queries HLR 120 for the location of mobile station 114, when a call is placed from terminal 102a. HLR 120 provides the requested subscriber location information to gateway 112b'. Subsequently, as depicted in FIG. 3b, gateway 112b' then

routes the call to MSC/VLR 122. This basic operation, therefore reduces that amount of processing/signaling support required by the various resources in PLMN 116.

[0023] In accordance with certain preferred embodiments of the present invention, the packetized call is proved directly to MSC/VLR 122 (e.g., to a transcoder/rate adaption unit therein) where the speech traffic is converted directly to its over-the-air format without an intervening decoding process. For example, the packetized call can be converted to G.711 PCM format. In this manner, the IP voice traffic is carried as far as possible in communications system 100', rather than being converted at an earlier stage/node.

[0024] Thus, gateway 112b' is configured to directly route calls to the MSC/VLR 122 in which the mobile station 114 is currently registered, thereby significantly optimizing the route, when compared to using GMSC 118. Gateway 112b' can be a standalone node, or can be an enhanced gateway or gatekeeper (in the case of H.323 networks) element.

[0025] Providing querying capabilities to applications within or connected to Internet 106, for example, raises several security concerns. One of these concerns is regulating which of the various applications can request/query or otherwise access the subscriber information within mobile communications network 116, and in particular, which of the various applications can access HLR 120 for location information directly. Another related concern is the need to monitor and control unintentional and/or intentional misuse of such a query capability.

[0026] Thus, in accordance with certain further embodiments of the present invention, roaming number application 200 not only includes an appropriate request/query interface capability, but also includes a policing function that controls and/or monitors access to the query capabilities.

[0027] By way of example, FIG. 4 is a block diagram 300 of a layered model of an exemplary location query and policing function (LQPF) within roaming number application 200, as embodied, for example, in gateway 112b'. As depicted the LQPF includes application layer 302, and protocol stacks 304 and 306. Protocol stack 304 is used to interface with mobile communications network 116, and protocol stack 306 is used to interface with Internet 106 (e.g., using H.323 compliant functions). Protocol stacks 304 and 306 are only examples, thus, other protocol stacks can be employed as required for other types of interfaces/configurations. It is preferred, however, that protocol stack 306 includes a reliable transport mechanism. Thus, for example, TCP as opposed to UDP is shown, because of the inherent danger of retries in the event of lost packets.

[0028] Referring to FIG. 4, LQPF 300 includes a Mobile Application Part (MAP) interface on the mobile communications network "side" (i.e., stack 304) and an IP-query interface H.245, for example, on the Internet "side" (i.e., stack 306). When a request for a roaming number is received on the IP interface side, the request will include a Source Address (e.g., the IP address, or MAC address, of the source entity) that identifies the source application/node. This "source identifier" is used in application 302 to verify that the source application/node is allowed to request subscriber information from HLR 120.

[0029] Application 302 performs at least two functions in accordance with certain preferred embodiments of the

present invention. The first function is an encapsulate/decapsulate function, which essentially converts the Internet request message (e.g., a H.245 message) into a corresponding mobile communications network message (e.g., a MAP message). During this conversion process, the source identifier is extracted.

[0030] The second function is a policing function in which the source identifier is examined to determine if the source is a trusted source that can query HLR 120. For example, the source identifier can be compared to an existing trusted database 308 that lists or otherwise defines those applications/nodes that can query HLR 120.

[0031] The policing function can also be used to further determine if the request for an HLR query is to be processed. For example, the policing function may determine that the HLR or other network resources are too busy to handle such a query, and/or that the source application/node has exceeded a threshold number of such requests over a defined period of time, or otherwise appears to be abusing the system in some way. The policing function, therefore, prevents unintentional or intentional misuse of the HLR query, which could be deleterious to the operation of the mobile communications network 116.

[0032] For further description, reference is now made to FIG. 4, wherein application 302 is configured to provide both decapsulation and encapsulation of the HLR query request message received through stack 306. Here, decapsulation essentially involves receiving the H.245 request packet, which includes a MSISDN or, more generally, the called party number for the mobile terminal 114. The packet also contains the identification of the application/node or user making the query request. For example, the packet can include the IP address of terminal 102a or ISP 110, etc. This "source identifier" is then used in the policing function. Here, encapsulation involves building the inputs to the MAP message (for instance Send Routing Information, in a GSM system) for delivery to the lower C7/S7 layers in stack 304. The MAP message is then passed on to HLR 120.

[0033] Preferably, encapsulation only takes place after the source identifier has been verified by the policing function, for example, using trusted database 308 or another trusted resource. Thus, encapsulation is only necessary if the policing function within application determines that the query should be allowed to continue.

[0034] FIG. 5 is a flow-chart depicting an exemplary process 400 for use in application 302, in accordance with certain embodiments of the present invention. Process 400 includes receiving the request for HLR query in step 402. In step 404, process 400 includes decapsulating the request. A policing function is conducted in step 406, wherein trusted database 308 is accessed to determine if the source identifier is allowed to query HLR 120. Next, in step 408, if the various tests within the policing function are satisfied, then an appropriate MAP message is built and sent to HLR 120. HLR 120 then returns the query with the location of mobile station 114 and the voice information is passed on through to MSC/VLR 122 and eventually transmitted to mobile station 114, using conventional techniques.

[0035] Although preferred embodiments of the system and method of the present invention have been illustrated in the accompanying drawings and described in the foregoing

detailed description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

What is claimed is:

1. An arrangement for use in a communications system having at least one packet switched network and at least one mobile communications network, the arrangement comprising:

at least one mobile station within the mobile communications network;

a resource locator, within the mobile communications network, the resource locator being configured to determine a route for incoming calls to the mobile station; and

an application within the packet switched network that is configured to request information from the resource locator about the route for incoming calls to the mobile station.

2. The arrangement as recited in claim 1, wherein the resource locator determines the route for incoming calls to the mobile station when queried by the application.

3. The arrangement as recited in claim 2, wherein the resource locator is a home location register (HLR) and the arrangement further includes at least one switching center, within the mobile communications network, to which the mobile station is registered, and the information about the route further includes information about the switching center.

4. The arrangement as recited in claim 3, wherein the arrangement further comprises at least one gateway, within the packet switched network, and wherein the application is substantially within the gateway.

5. The arrangement as recited in claim 4, wherein the application further comprises a policing function that determines if a request for the route information is sent from the gateway to the resource locator.

6. The arrangement as recited in claim 5, wherein the policing function is further configured to verify if a source, as identified by the application, is allowed to query the resource locator for the route information.

7. The arrangement as recited in claim 6, wherein the arrangement further comprises at least one trusted database that is configured to be accessed by the policing function in the application to determine if the source is allowed to query the resource locator for the route information.

8. The arrangement as recited in claim 4, wherein the application is further configured to receive a request message through the packet switched network and output a query message to the HLR.

9. The arrangement as recited in claim 8, wherein the request message is a H.245 formatted message received through a TCP/IP protocol stack.

10. The arrangement as recited in claim 8, wherein the query message is a MAP formatted message.

11. An apparatus for use in a communications system having a mobile communications network that includes at least one mobile station and a resource locator determining a route for incoming calls to the mobile station, the apparatus comprising at least one application within a packet switched network that is configured to communicate to the

resource locator within the mobile communications network and thereby request information from the resource locator about the route for incoming calls to the mobile station.

12. The apparatus as recited in claim 11, wherein a request from the application causes the resource locator to determine the route for incoming calls to the mobile station.

13. The apparatus as recited in claim 12, wherein the request from the application causes the resource locator to access a home location register (HLR), within the mobile communications network, that identifies a switching center, also within the mobile communications network, to which the mobile station is registered, and the information about the route further includes information about the switching center.

14. The apparatus as recited in claim 13, wherein the application is substantially within at least one gateway, within the packet switched network.

15. The apparatus as recited in claim 14, wherein the application further comprises a policing function that determines if a request for the route information is sent from the gateway to the resource locator.

16. The apparatus as recited in claim 15, wherein the policing function is further configured to verify if a source, as identified by the application, is allowed to query the resource locator for the route information.

17. The apparatus as recited in claim 16, wherein the apparatus further comprises at least one trusted database that is configured to be accessed by the policing function in the application to determine if the source is allowed to query the resource locator for the route information.

18. The apparatus as recited in claim 14, wherein the application is further configured to receive a request message through the packet switched network and output a query message to the HLR.

19. The apparatus as recited in claim 18, wherein the request message is a H.245 formatted message received through a TCP/IP protocol stack.

20. The apparatus as recited in claim 18, wherein the query message is a MAP formatted message.

21. A method for routing a call from a packet switched network to a mobile communications network, the method comprising:

identifying within the packet switched network that a called party is a mobile subscriber within the mobile communications network;

from within the packet switched network, directly accessing routing information about the called party from within at least one location register within the mobile communications network; and

routing a call to the mobile subscriber through at least one switching center within the mobile communications network as identified in the routing information.

22. The method as recited in claim 21, wherein the step of directly accessing the routing information further comprises verifying that a requesting source be allowed to access the routing information.

23. The method as recited in claim 22, wherein the step of routing the call to the mobile subscriber through the switching center is only conducted if the step of verifying that the requesting source is allowed to access the routing information has been satisfied.

24. The method as recited in claim 23, wherein the routing information includes information about the location of the mobile subscriber within the mobile communications network.

25. The method as recited in claim 24, wherein the step of identifying that the called party is a mobile subscriber within the mobile communications network further comprises decapsulating a request message.

26. The method as recited in claim 25, wherein the step of directly accessing routing information about the called party further comprises encapsulating at least a portion of the request message, as decapsulated.

27. The method as recited in claim 26, wherein the step of routing the call to the mobile subscriber through the switching center further comprises building at least one MAP message.

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(12) **United States Patent**
Shur et al.

(10) **Patent No.:** US 6,259,701 B1
(45) **Date of Patent:** Jul. 10, 2001

(54) **METHOD AND SYSTEM FOR A UNICAST ENDPOINT CLIENT TO ACCESS A MULTICAST INTERNET PROTOCOL (IP) SESSION**

(75) **Inventors:** David Hilton Shur, Middletown;
Aleksandr Zeleznjak, Matawan, both
of NJ (US)

(73) **Assignee:** AT&T Corp., New York, NY (US)

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(22) **Filed:** Sep. 11, 1997

(51) **Int. Cl.⁷** H04L 12/28; H04J 3/26

(52) **U.S. Cl.** 370/401; 370/252; 370/432

(58) **Field of Search** 370/252, 253,
370/254, 400, 401, 408, 432, 390, 392;
709/203, 204, 206, 205, 227, 228, 229,
230, 231

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Primary Examiner—Wellington Chin
Assistant Examiner—Steven Nguyen

(57) **ABSTRACT**

Unicast endpoint clients (110, 111, 115) on an IP Unicast network (107, 108) are provided access to Multicast sessions on an IP Multicast network (101) through a Multicast-Unicast gateway server (120, 121). The server obtains information about sessions on the Multicast network and makes such information available to a Unicast client on the Unicast network upon request by the client. Upon being presented with a list describing the subject matter of each session, the user at the Unicast client selects the session to which he or she wants to join, which causes the Multicast-Unicast server to join the appropriate session on behalf of the requesting client for each media type in which the joining client wants to be a participant. The server then sets a bidirectional Unicast User Datagram Protocol (UDP) stream between itself and the client. All packets then received by the server from the Unicast client are address-translated to the appropriate Multicast session address. In addition, all packets received by the server on the Multicast session address are address-translated and sent to the Unicast client. The Unicast client is then able to participate in the Multicast session as both a sender and a receiver of packets to and from other Unicast and Multicast clients which are active during the session. Further, the Unicast client is capable of creating a new session, recording a session in the network for later retrieval and playback, and creating and accessing low bandwidth versions of existing sessions.

15 Claims, 7 Drawing Sheets

